



US009373050B2

(12) **United States Patent**
Konno

(10) **Patent No.:** **US 9,373,050 B2**
(45) **Date of Patent:** **Jun. 21, 2016**

(54) **IMAGE PROCESSING APPARATUS, IMAGE CAPTURING APPARATUS, AND METHOD OF CONTROLLING THE SAME**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(71) Applicant: **CANON KABUSHIKI KAISHA**,
Tokyo (JP)

6,661,455 B1 * 12/2003 Toyofuku H04N 1/215
348/218.1
7,042,504 B1 * 5/2006 Toyofuku H04N 1/2112
348/231.1

(72) Inventor: **Ryuhei Konno**, Kawasaki (JP)

(Continued)

(73) Assignee: **CANON KABUSHIKI KAISHA**,
Tokyo (JP)

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

JP 2005-286940 A 10/2005
JP 2007-199757 A 8/2007

(Continued)

(21) Appl. No.: **14/094,106**

OTHER PUBLICATIONS

(22) Filed: **Dec. 2, 2013**

The above foreign patent documents were cited in the Mar. 2, 2015 Japanese Office Action, which is enclosed without an English Translation, that issued in Japanese Patent Application No. 2014-085881.

(65) **Prior Publication Data**

US 2014/0078339 A1 Mar. 20, 2014

(Continued)

Related U.S. Application Data

(63) Continuation of application No. 13/774,133, filed on Feb. 22, 2013, now Pat. No. 8,837,865, which is a continuation of application No. 13/005,367, filed on Jan. 12, 2011, now Pat. No. 8,401,338.

Primary Examiner — Yosef Kassa

(74) *Attorney, Agent, or Firm* — Cowan, Liebowitz & Latman, P.C.

(30) **Foreign Application Priority Data**

Feb. 5, 2010 (JP) 2010-024832

(57) **ABSTRACT**

The present invention provides an image processing apparatus for performing image processing of image data in which information specifying, on a first coordinate system, a position of a portion of interest in an image is recorded, including an image processing unit configured to perform rotation processing of the image data using a second coordinate system having an origin different from that of the first coordinate system, and a change unit configured to change the information specifying the position of the portion of interest in accordance with a rotation amount of the image data by the rotation processing such that an image of the portion of interest specified by the information specifying the position of the portion of interest after the rotation processing matches that before the rotation processing.

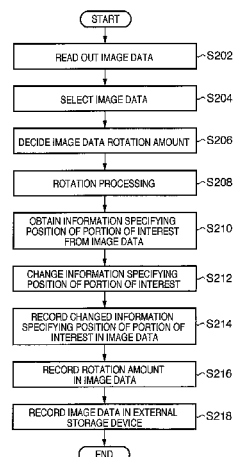
(51) **Int. Cl.**
G06K 9/32 (2006.01)
H04N 5/232 (2006.01)
H04N 5/262 (2006.01)

(52) **U.S. Cl.**
CPC **G06K 9/32** (2013.01); **H04N 5/23212** (2013.01); **H04N 5/23293** (2013.01); **H04N 5/2621** (2013.01); **H04N 5/2628** (2013.01)

(58) **Field of Classification Search**
USPC 382/289, 291, 293, 295, 296, 297;
345/649, 659

See application file for complete search history.

47 Claims, 5 Drawing Sheets



References Cited

8,811,833	B2 *	8/2014	Adachi et al.	399/27
2004/0052431	A1 *	3/2004	Locker et al.	382/296

7,623,697	B1 *	11/2009	Hughes	G06F 3/04845 345/626
7,993,272	B2 *	8/2011	Chomas	A61B 8/14 600/437
8,189,965	B2 *	5/2012	Edgar et al.	382/313
8,233,962	B2 *	7/2012	Kukuk	A61B 6/481 378/62
8,325,247	B2 *	12/2012	Kamiya	G06T 3/0062 348/222.1
8,391,645	B2 *	3/2013	Steinberg et al.	382/296
8,400,693	B2 *	3/2013	Uwatoko	358/504
8,538,110	B2 *	9/2013	Nakai	A61B 6/032 382/131
8,780,116	B2 *	7/2014	Abe et al.	345/441

JP	2008-003335	A	1/2008
JP	2009-065635	A	3/2009
JP	2009-071549	A	4/2009
JP	2009-124314	A	6/2009
JP	2009-296031	A	12/2009
JP	2009-302657	A	12/2009

Dec. 20, 2013 Japanese Office Action that issued in Japanese Patent Application No. 2010-024832.

* cited by examiner

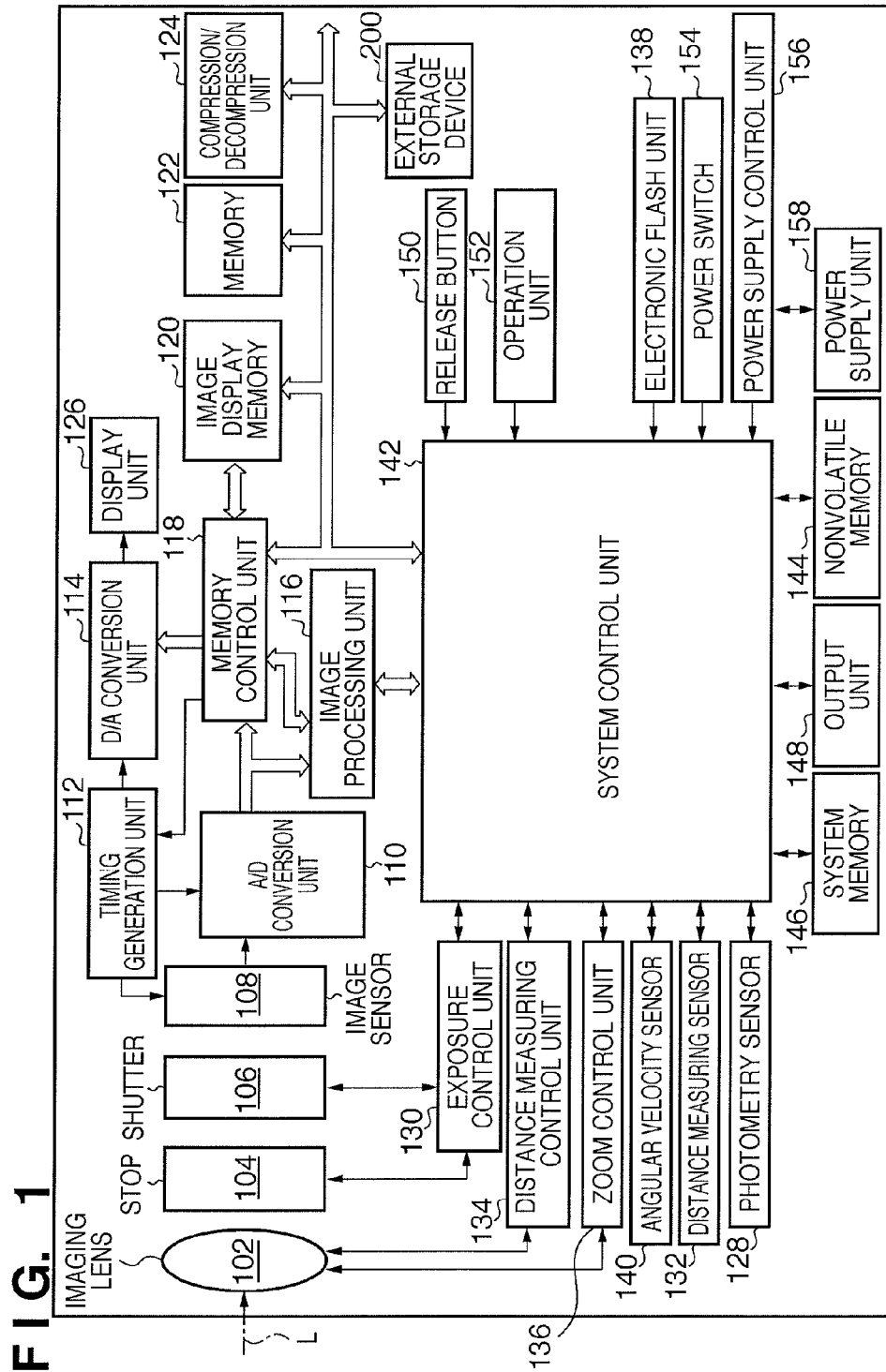


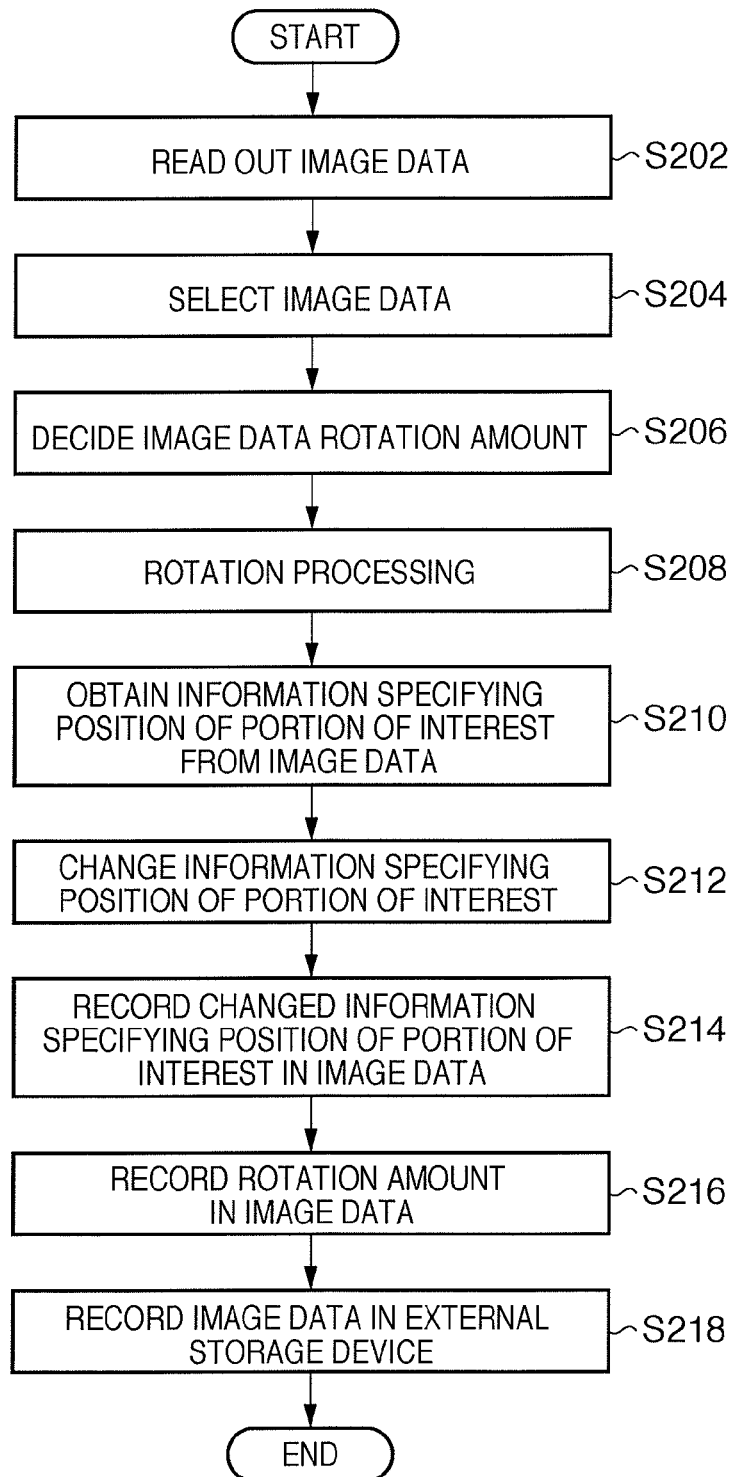
FIG. 2

FIG. 3A

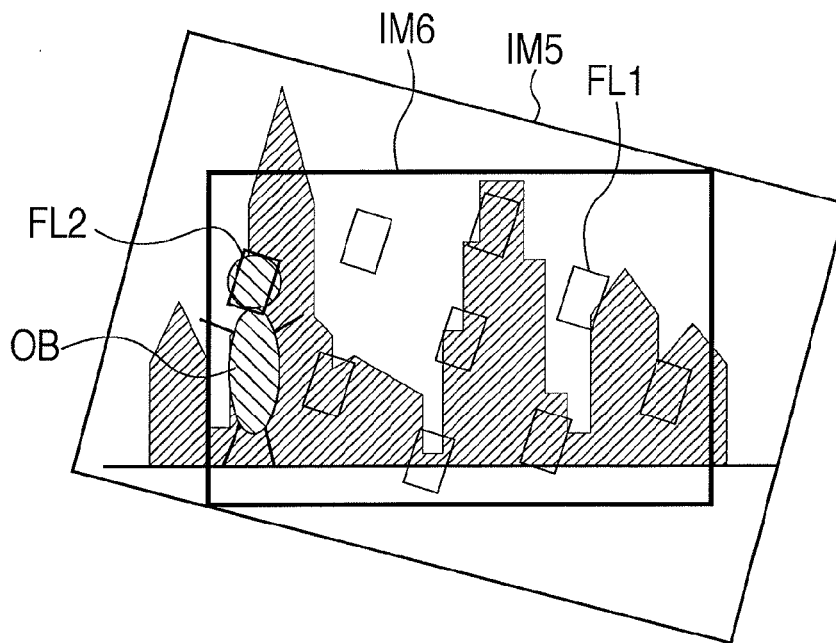


FIG. 3B

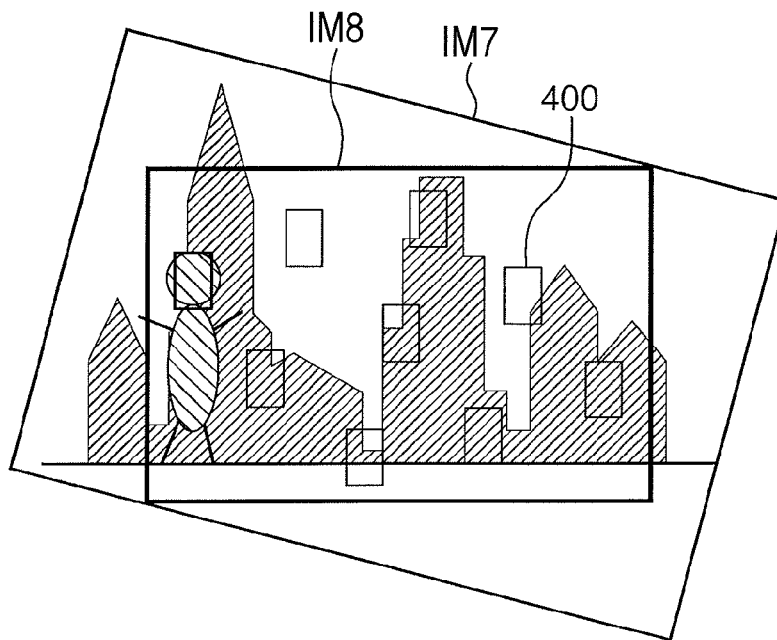


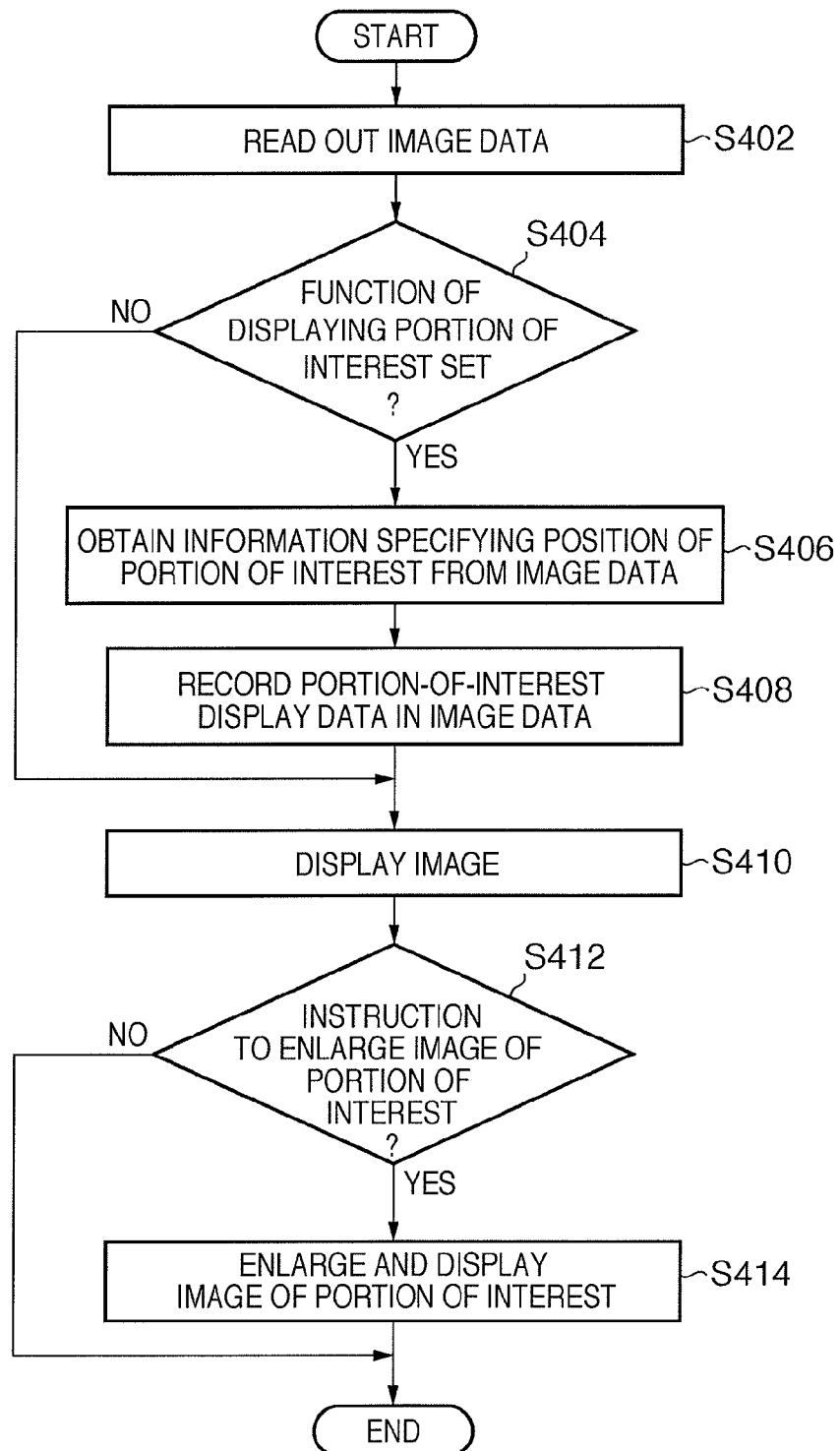
FIG. 4

FIG. 5A

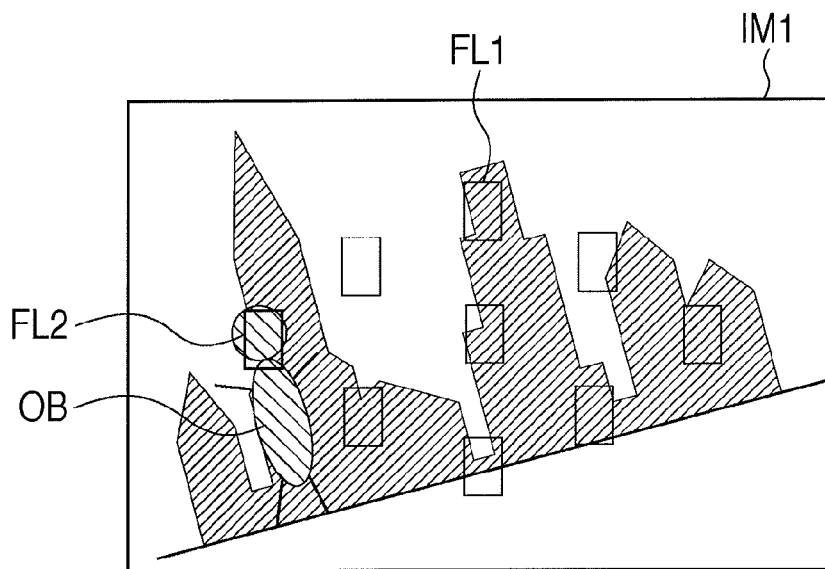


FIG. 5B

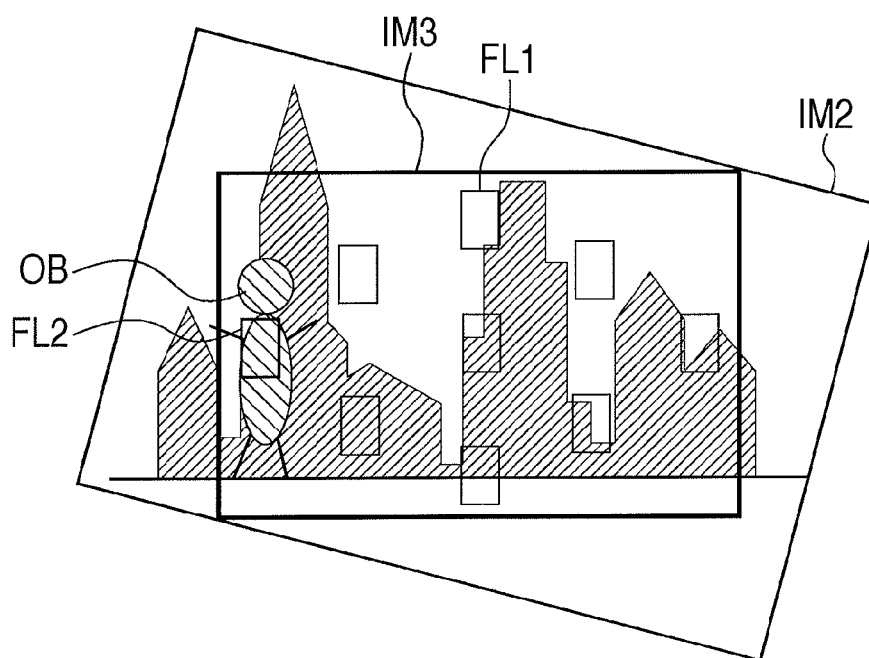


IMAGE PROCESSING APPARATUS, IMAGE CAPTURING APPARATUS, AND METHOD OF CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 13/774,133, filed Feb. 22, 2013; which is a continuation of application Ser. No. 13/005,367, filed Jan. 12, 2011, now U.S. Pat. No. 8,401,338, the entire disclosures of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image processing apparatus, image capturing apparatus, and method of controlling the same.

2. Description of the Related Art

There is known a function of, when reproducing (displaying) an image captured by an image capturing apparatus on an image processing apparatus (image processing application software), displaying distance measuring frames (to be referred to as “AF frames” hereinafter) used for auto focus (AF) at the time of image capturing. For example, Japanese Patent Laid-Open No. 2000-125178 proposes a technique of recording, in an image (image data), the position information of an AF frame (to be referred to as an “in-focus AF frame” hereinafter) used to bring an object into focus and displaying the in-focus AF frame at the time of image reproduction to facilitate confirming image focus. This technique also allows to automatically enlarge the image in the in-focus AF frame.

On the other hand, an image captured by the image capturing apparatus sometimes tilts in the horizontal direction due to the influence of the posture of the image capturing apparatus. Rotation processing of rotating the captured image to correct the tilt has been proposed as one of image processes.

However, when the image is rotated, and the in-focus AF frame is displayed directly using the position information of the AF frame recorded in the image, the in-focus AF frame is displayed in the rotated image at a position shifted from the actual in-focus AF frame position.

The problem of the prior art will be described in detail with reference to FIGS. 5A and 5B. FIG. 5A is a view showing a display example in which an in-focus AF frame is displayed in an image IM1 (that is, an image before rotation processing) that tilts in the horizontal direction. Referring to FIG. 5A, nine rectangular frames represent AF frames FL1 selectable at the time of image capturing. Out of the nine rectangular frames, a rectangular frame indicated by a bold line represents an in-focus AF frame FL2 used to focus on (the face of) an object OB by the AF function.

FIG. 5B is a view showing a display example in which the in-focus AF frame is displayed in an image IM2 obtained by performing rotation processing for the image IM1 shown in FIG. 5A so as to set the object OB in a horizontal position. Referring to FIG. 5B, an image IM3 is obtained by cutting out, from the image IM2 after the rotation processing, a region inscribed in the image region of the image IM2 not to include any image region absent in the image IM1 before the rotation processing. The position of the object OB in the image IM2 that has undergone the rotation processing is shifted from its position in the image IM1 before the rotation processing. The AF frames FL1 and the in-focus AF frame

FL2 are displayed in the image IM3 using position information cut out upon cutting out the image IM3 from the image IM2.

As described above, when the AF frames FL1 and the in-focus AF frame FL2 are displayed in the image IM3 directly using the position information recorded in the image IM1, the in-focus AF frame FL2 is displayed at a position shifted from the position of the face of the object OB (actual in-focus AF frame position) in the image IM3.

SUMMARY OF THE INVENTION

The present invention provides a technique capable of displaying, in an image after rotation processing, a portion of interest at the same position as that in the image before the rotation processing.

According to one aspect of the present invention, there is provided an image processing apparatus for performing image processing of image data in which information specifying, on a first coordinate system, a position of a portion of interest in an image is recorded, comprising: an image processing unit configured to perform rotation processing of the image data using a second coordinate system having an origin different from that of the first coordinate system; and a change unit configured to change the information specifying the position of the portion of interest in accordance with a rotation amount of the image data by the rotation processing such that an image of the portion of interest specified by the information specifying the position of the portion of interest after the rotation processing matches that before the rotation processing.

Further aspects of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram showing an image capturing apparatus according to an embodiment of the present invention.

FIG. 2 is a flowchart for explaining image data rotation processing in the image capturing apparatus shown in FIG. 1.

FIGS. 3A and 3B are views showing display examples in which AF frames are displayed in an image obtained by performing rotation processing for an image shown in FIG. 5A so as to set an object in a horizontal position according to the embodiment.

FIG. 4 is a flowchart for explaining display control processing in the image capturing apparatus shown in FIG. 1.

FIGS. 5A and 5B are views for explaining a problem of a prior art.

DESCRIPTION OF THE EMBODIMENTS

Preferred embodiments of the present invention will be described below with reference to the accompanying drawings. Note that the same reference numerals denote the same members throughout the drawings, and a repetitive description thereof will not be given.

FIG. 1 is a schematic block diagram showing an image capturing apparatus 100 according to an embodiment of the present invention. The image capturing apparatus 100 is an image capturing apparatus for capturing an object and is implemented as a digital camera in this embodiment. The image capturing apparatus 100 records image data corresponding to a captured image in an external storage device 200 connected to the image capturing apparatus 100, and also

displays (reproduces) an image corresponding to image data recorded in the external storage device **200**.

An imaging lens **102** forms an image of light L from an object (that is, forms an optical image) on the imaging plane of an image sensor **108**. The image sensor **108** is formed from, for example, a CCD or CMOS device (photoelectric conversion device), and converts an optical image formed through the imaging lens **102**, stop **104**, and shutter **106** into an electrical signal. An A/D conversion unit **110** converts an analog signal (analog data) output from the image sensor **108** into a digital signal (digital data). A timing generation unit **112** supplies clock signals and control signals to the image sensor **108**, A/D conversion unit **110**, and D/A conversion unit **114** and controls their operations under the control of a memory control unit **118** and a system control unit **142**.

An image processing unit **116** performs various kinds of processing for data input from the A/D conversion unit **110** or data input from the memory control unit **118**. For example, the image processing unit **116** performs white balance processing, color correction processing, rotation processing, dust detection processing of detecting dust sticking to the image sensor **108**, dust erase processing of making such dust unnoticeable, and the like. Note that rotation processing rotates image data using a coordinate system (second coordinate system) having an origin different from that of the coordinate system (first coordinate system) of the image data before rotation processing so as to correct a tilt.

The memory control unit **118** controls the A/D conversion unit **110**, timing generation unit **112**, D/A conversion unit **114**, image processing unit **116**, image display memory **120**, memory **122**, and compression/decompression unit **124**. The digital signal A/D-converted by the A/D conversion unit **110** is recorded (written) in the image display memory **120** or the memory **122** via the image processing unit **116** and the memory control unit **118** or via the memory control unit **118**.

The image display memory **120** stores image data corresponding to an image displayed on a display unit **126**. The memory **122** stores image data (for example, still image data and moving image data captured by the image capturing apparatus **100**), and has a storage capacity capable of storing a predetermined number of image data. The memory **122** is also usable as the work area of the image processing unit **116** or the system control unit **142**.

The compression/decompression unit **124** reads out image data from the memory **122** and compresses it, or reads out compressed image data from the memory **122** and decompresses it, and records the processed image data in the memory **122**.

The display unit **126** includes a TFT (Thin Film Transistor) or an LCD (Liquid Crystal Display), and displays, via the D/A conversion unit **114**, an image corresponding to image data stored in the image display memory **120**. The display unit **126** also displays various kinds of menu screens (for example, a menu screen to be used to set rotation processing) to control the image capturing apparatus **100**. Display of these menu screens or setting and selection on the menu screens are done by a user operation on an operation unit **152**.

A photometry sensor **128** detects the luminance of each pixel conjugate to the imaging plane of the image sensor **108** and inputs it to the system control unit **142**. The system control unit **142** calculates an appropriate exposure amount corresponding to the detection result of the photometry sensor **128**. An exposure control unit **130** controls the stop **104** and the shutter **106** based on the exposure amount calculated by the system control unit **142**.

A distance measuring sensor **132** detects the distance information of a distance measuring point (AF frame) arbitrarily

selected by the user. However, the distance measuring point need not always be arbitrarily selected by the user, and may be set to automatically focus on an object in the shortest distance based on the detection result of the distance measuring sensor **132**. A distance measuring control unit **134** controls focusing of the imaging lens **102** based on the detection result of the distance measuring sensor **132**.

A zoom control unit **136** detects the zooming amount (focal length) of the imaging lens **102** manually operated by the user. When the imaging lens **102** automatically zooms, the zoom control unit **136** controls the zooming amount of the imaging lens **102**. An electronic flash unit **138** has an AF auxiliary light projecting function and an electronic flash brightness control function. An angular velocity sensor **140** detects horizontal and vertical shakes of the image capturing apparatus **100**, and is used for camera shake correction processing or portrait/landscape image capturing determination.

The system control unit **142** controls the entire image capturing apparatus **100**. The system control unit **142** executes programs stored in a nonvolatile memory **144** to execute the processing of this embodiment. The nonvolatile memory **144** is a memory capable of electrically erasing and recording data and includes, for example, an EEPROM. The nonvolatile memory **144** stores constants and programs (programs to be used to execute various flowcharts to be described later) for the operation of the system control unit **142**. A system memory **146** is formed from, for example, a RAM and rasterizes the constants and variables for the operation of the system control unit **142** and programs read out from the nonvolatile memory **144**.

An output unit **148** includes a display device which displays the operation states of the image capturing apparatus **100** and messages by texts or images and a speaker which outputs them by voices in accordance with program execution in the system control unit **142**. The output unit **148** displays single shooting/sequential shooting, timer, compression ratio, number of recording pixels, number of recorded images, and number of recordable images. The output unit **148** also displays the shutter speed, F-number, exposure compensation, battery level, error, and the attached/detached state of the external storage device **200**.

A release button **150** is used to instruct to capture an object and includes a first switch and a second switch. When the release button **150** is operated (pressed) halfway, the first switch is turned on to supply a signal for starting photometry processing or distance measuring processing to the system control unit **142**. When the release button **150** is operated (pressed) fully, the second switch is turned on to supply a signal for starting exposure processing to the system control unit **142**.

The operation unit **152** includes setting buttons, selection buttons, and a touch panel provided on the display unit **126**, and has a function of accepting user operations (inputting various kinds of instructions to the system control unit **142**). The operation unit **152** is used for, for example, single shooting/sequential shooting/self timer switching and setting of the shutter speed, F-number, and exposure compensation.

A power switch **154** is used to switch the power state of the image capturing apparatus **100** between an ON state and an OFF state. A power supply control unit **156** includes a battery detection circuit, DC/DC converter, and switching circuit for switching a block to be energized, and detects the presence/absence of a battery attached to a power supply unit **158**, the type of battery, and the battery level. Additionally, the power supply control unit **156** controls the DC/DC converter based on the detection result in the power supply unit **158** and an instruction from the system control unit **142** so as to supply a

necessary voltage to the units of the image capturing apparatus **100** including the external storage device **200** during a necessary period. The power supply unit **158** detachably holds a primary cell such as an alkaline cell or a lithium cell, a secondary cell such as an NiCd cell, NiMH cell, or Li cell, or an AC adapter, and outputs a voltage (DC voltage).

The external storage device **200** is a storage medium detachable from the image capturing apparatus **100**, and includes a CF (Compact Flash®) card and an SD card. Image data temporarily recorded in the memory **122** is finally recorded in the external storage device **200**.

Various kinds of processing (operations) of the image capturing apparatus **100** will be described below. Rotating an image corresponding to image data recorded in the external storage device **200**, that is, image data rotation processing in the image capturing apparatus **100** will be described first with reference to FIG. 2. Image data recorded in the external storage device **200** can be either image data generated by the image capturing apparatus **100** or image data generated by another image capturing apparatus. Information specifying (on the first coordinate system) the position of a portion of interest in the image is recorded in (the image header field of) the image data.

In step **S202**, the system control unit **142** reads out image data from the external storage device **200** to the image display memory **120**. At this time, the system control unit **142** displays, on the display unit **126**, an image corresponding to the image data read out to the image display memory **120**. The image displayed on the display unit **126** can be switched by a user operation (for example, a user operation on the operation unit **152** to input an image switching instruction). That is, upon receiving an image switching instruction, the system control unit **142** reads out another image data from the external storage device **200** to the image display memory **120** and displays an image corresponding to the image data on the display unit **126**.

In step **S204**, the system control unit **142** selects process target image data to be subjected to rotation processing from the image data read out in step **S202** in accordance with a user operation (for example, a user operation on the operation unit **152** to input an image selection instruction).

In step **S206**, the system control unit **142** decides the image data rotation amount of image processing (image data rotation amount necessary for correcting the tilt of the image). For example, the system control unit **142** decides the image data rotation amount in accordance with a user operation. At this time, the system control unit **142** instructs the image processing unit **116** to rotate the image data based on the rotation amount input by the user and displays, on the display unit **126**, an image corresponding to the image data rotated by the image processing unit **116**. Hence, the user can confirm the image displayed on the display unit **126** while increasing/decreasing the image data rotation amount to be input and finally decide the image data rotation amount.

In step **S208**, the system control unit **142** instructs the image processing unit **116** to perform rotation processing of the image data selected in step **S204** based on the rotation amount decided in step **S206** so that the image processing unit **116** performs image data rotation processing. Note that the image data rotation processing can be implemented by a rotation processing algorithm known to those skilled in the art, and a detailed description thereof will be omitted.

In step **S210**, the system control unit **142** obtains, from the image data selected in step **S204**, information specifying the position of a portion of interest in the image. Examples of the portion of interest are a portion corresponding to a distance measuring frame (AF frame) for auto focus, a portion corre-

sponding to the face (including eyes, nose, and mouth) of an object detected by face detection processing, and a portion corresponding to a dust particle sticking to the image sensor **108** and detected by dust detection processing. Note that the AF frames include at least one of an AF frame selectable upon generating image data and an AF frame (in-focus AF frame) used to bring the object into focus at the time of image data generation.

In step **S212**, the system control unit **142** changes the information specifying the position of the portion of interest in accordance with the rotation amount decided in step **S206** such that the image of the portion of interest specified by the information specifying the position of the portion of interest after the rotation processing (**S208**) matches that before the rotation processing.

Step **S212** will be described in detail. Assume that the portion of interest is an AF frame selectable upon image data generation or an in-focus AF frame used to bring the object into focus at the time of image data generation. The AF frame generally has a rectangular shape, as shown in FIGS. 5A and 5B. Hence, in this embodiment, the information specifying the position of the portion of interest, that is, the AF frame includes four coordinate points representing the positions of the four vertices of the rectangular shape of the AF frame so as to represent the position and size of the AF frame. Note that the information specifying the position of the AF frame may be one coordinate point representing the position of one point (for example, one of the four vertices of the rectangular shape or the central point of the rectangular shape) included in the AF frame (distance measuring frame). In this case, however, the image data needs to record information representing the rectangular shape based on the one coordinate point. If there are nine AF frames selectable in the image capturing apparatus at the time of image data generation, as shown in FIGS. 5A and 5B, the above-described four coordinate points representing the positions of four vertices are included for each of the nine AF frames.

The system control unit **142** obtains the above-described four coordinate points representing the positions of the four vertices (**S210**), and changes the four coordinate points serving as the information specifying the position of the portion of interest by the same processing as the image data rotation processing of the image processing unit **116**. This allows to display the AF frame at the actual AF frame position (the position of the AF frame in the image before the rotation processing) even in the image that has undergone the rotation processing.

In step **S214**, the system control unit **142** records the information specifying the position of the portion of interest, which is changed in step **S212**, in (the image header field of) the image data.

Note that in this embodiment, the information specifying the position of an AF frame serving as a portion of interest includes four coordinate points representing the positions of the four vertices of the rectangular shape of the AF frame, and each of the four coordinate points is changed based on the rotation amount decided in step **S206** and recorded in the image data. Hence, each AF frame is displayed in the rotated image using the four coordinate points recorded in step **S214**, as shown in FIG. 3A. FIG. 3A is a view showing a display example in which AF frames FL1 and an in-focus AF frame FL2 are displayed in an image IM5 obtained by performing rotation processing for an image IM1 shown in FIG. 5A so as to set an object OB in a horizontal position. Referring to FIG. 3A, an image IM6 is obtained by cutting out, from the image IM5 after the rotation processing, a region inscribed in the image region of the image IM5 not to include any image

7

region absent in the image IM1 before the rotation processing. Note that when cutting out the image, the information specifying the position of the portion of interest recorded in the image data is also shifted in accordance with image cut-out. As shown in FIG. 3A, each of the AF frames FL1 and the in-focus AF frame FL2 is displayed in the image IM5 using the four coordinate points changed based on the rotation amount decided in step S206. Hence, the AF frames FL1 and the in-focus AF frame FL2 are displayed at the actual positions (the positions of the AF frames in the image before the rotation processing) in a state rotated based on the rotation amount.

On the other hand, when the information specifying the position of an AF frame includes one coordinate point representing the position of one point included in the AF frame, only the one coordinate point is changed based on the rotation amount decided in step S206 and recorded in the image data. Hence, each AF frame is displayed in the rotated image using the one coordinate point recorded in step S214 and information representing the rectangular shape based on the one coordinate point recorded in the image, as shown in FIG. 3B. FIG. 3B is a view showing a display example in which the AF frames FL1 and the in-focus AF frame FL2 are displayed in an image IM7 obtained by performing rotation processing for the image IM1 shown in FIG. 5A so as to set the object OB in a horizontal position. Referring to FIG. 3B, an image IM8 is obtained by cutting out, from the image IM7 after the rotation processing, a region inscribed in the image region of the image IM7 not to include any image region absent in the image IM1 before the rotation processing. As shown in FIG. 3B, each of the AF frames FL1 and the in-focus AF frame FL2 is displayed in the image IM7 using the one coordinate point changed based on the rotation amount decided in step S206 and the information representing the rectangular shape based on the one coordinate point. Hence, the AF frames FL1 and the in-focus AF frame FL2 are displayed at the actual positions (the positions of the AF frames in the image before the rotation processing). However, since the information representing the rectangular shape based on one coordinate point has not changed based on the rotation processing (rotation amount), the AF frames FL1 and the in-focus AF frame FL2 are displayed in the image IM7 without being rotated, resulting in display with a sense of incongruity. To display rotated AF frames in the rotated image, the system control unit 142 records the rotation amount decided in step S206 in (the image header field of) the image data in step S216. This enables to display the AF frames rotated based on the rotation amount decided in step S206. Note that when the information specifying the position of an AF frame includes four coordinate points representing the positions of the four vertices of the rectangular shape of the AF frame, the AF frame can be displayed while being rotated using the four coordinate points recorded in step S214, as described above. Hence, recording the rotation amount decided in step S206 in the image data, that is, step S216 needs not be performed.

In step S218, the system control unit 142 records, in the external storage device 200, the image data which has recorded the information specifying the position of the portion of interest, which is changed in step S212, (and the rotation amount decided in step S206).

Note that in this embodiment, rotation processing of image data recorded in the external storage device 200 has been described. However, the present invention is not limited to this. For example, rotation processing may be performed before recording image data in the external storage device 200. In this case, the image data rotation amount is decided using the detection result of the angular velocity sensor 140,

8

and information specifying the position of the portion of interest is changed based on the rotation amount and recorded in the image data, as described above.

Reading out image data stored in the external storage device 200 and displaying an image corresponding to the image data on the display unit 126, that is, display control processing in the image capturing apparatus 100 will be described next with reference to FIG. 4.

In step S402, the system control unit 142 reads out image data from the external storage device 200 to the image display memory 120.

In step S404, the system control unit 142 determines whether a function of displaying a portion of interest (for example, AF frame) of the image is set. The function of displaying the portion of interest of the image is set by a user operation on the operation unit 152. When the function of displaying the portion of interest of the image is set, for example, a portion-of-interest display function flag is validated. The system control unit 142 can determine, by referring to the portion-of-interest display function flag, whether the function of displaying the portion of interest of the image is set. If the function of displaying the portion of interest of the image is set, the process advances to step S406. If the function of displaying the portion of interest of the image is not set, the process advances to step S410.

In step S406, the system control unit 142 obtains information specifying the position of the portion of interest from the image data read out in step S402. If the image data rotation amount and other information (for example, information representing a rectangular shape based on one coordinate point) are recorded in the image data, these pieces of information are also obtained.

In step S408, the system control unit 142 generates portion-of-interest display data (for example, data representing a rectangular AF frame serving as the portion of interest) based on the information specifying the position of the portion of interest obtained in step S406 and records it in (the image header field of) the image data. If the image data rotation amount and other information have also been obtained in step S406, the portion-of-interest display data is generated based on the information specifying the position of the portion of interest, the rotation amount, and other information.

In step S410, the system control unit 142 displays the image on the display unit 126. If the function of displaying the portion of interest of the image is not set, the image corresponding to the image data read out in step S402 is directly displayed (that is, the portion of interest is not displayed). On the other hand, if the function of displaying the portion of interest of the image is set, the image corresponding to the image data read out in step S402 is displayed. In addition, the portion of interest corresponding to the portion-of-interest display data recorded in step S408 is displayed in the image. In this case, even when the image data has undergone rotation processing, the information specifying the position of the portion of interest recorded in the image data is changed based on the image data rotation amount, as described above. Hence, as shown in FIG. 3A, the portion of interest can be displayed at the actual position in the image after the rotation processing while being rotated based on the image data rotation amount.

In step S412, the system control unit 142 determines whether an instruction is input to enlarge the image of the portion of interest in the image displayed in step S410. Note that the instruction to enlarge the image of the portion of interest is input by a user operation on the operation unit 152. If the instruction to enlarge the image of the portion of interest is not input, the display control processing ends. On the other

hand, if the instruction to enlarge the image of the portion of interest is input, the system control unit 142 enlarges the image of the portion of interest and displays it in step S414. Any enlarging method known to those skilled in the art is applicable to enlarge the image of the portion of interest, and a detailed description thereof will be omitted.

Note that if the portion of interest is a portion corresponding to a dust particle sticking to the image sensor 108, the system control unit may determine in step S412 whether a dust erase processing instruction is input so that dust erase processing is performed in step S414.

As described above, according to the image capturing apparatus 100 of this embodiment, when performing rotation processing of image data, information specifying the position of a portion of interest, which is recorded in the image data, is also changed based on the image data rotation amount. This makes it possible to display, in an image after rotation processing, a portion of interest at the same position as that in the image before the rotation processing.

In this embodiment, image data rotation processing in an image capturing apparatus has been described. However, the present invention is not limited to this. The present invention can also be implemented in an image processing apparatus (image processing application software) such as a personal computer.

Aspects of the present invention can also be realized by a computer of a system or apparatus (or devices such as a CPU or MPU) that reads out and executes a program recorded on a memory device to perform the functions of the above-described embodiments, and by a method, the steps of which are performed by a computer of a system or apparatus by, for example, reading out and executing a program recorded on a memory device to perform the functions of the above-described embodiments. For this purpose, the program is provided to the computer for example via a network or from a recording medium of various types serving as the memory device (for example, computer-readable medium).

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent application No. 2010-024832 filed on Feb. 5, 2010, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, comprising:

a first processing unit configured to perform rotation processing of the image data;
a second processing unit configured to perform rotation processing of the region of interest in accordance with a rotation of the image data by the first processing unit, wherein the image data is generated by an image capturing apparatus, and
the region of interest is a portion corresponding to a frame for auto focus, the portion is used to focus on an object by the image capturing apparatus upon generating the image data.

2. The apparatus according to claim 1, wherein the second processing unit configured to perform the rotation processing of the region of interest in accordance with a rotation amount of the image data by the first processing unit.

3. The apparatus according to claim 1, further comprising a display control unit configured to control to display an image based on the region of interest in addition to displaying an image corresponding to the image data.

4. The apparatus according to claim 1, wherein the frame is selectable in the image capturing apparatus upon generating the image data.

5. The apparatus according to claim 1, wherein the region of interest has a rectangular shape.

6. The apparatus according to claim 1, further comprising a display control unit configured to, when displaying, on a display unit, an image corresponding to the image data which has undergone the rotation processing by the first processing unit, display distance image in accordance to the position of the region of interest.

7. The apparatus according to claim 1, further comprising a display control unit configured to control to display a frame based on the region of interest, wherein the display control unit rotates the frame in accordance with a rotation amount of the image data by the first processing unit.

8. An image capturing apparatus comprising:

an image capturing unit configured to capture an object to generate image data; and

an image processing apparatus of claim 1 which performs image processing of the image data generated by the image capturing unit.

9. The apparatus according to claim 1, wherein the first processing unit and the second processing unit are configured in a unit.

10. An image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, comprising:

a first processing unit configured to perform rotation processing of the image data;

a second processing unit configured to perform rotation processing of the region of interest in accordance with a rotation of the image data by the first processing unit, wherein the image data is generated by an image capturing apparatus, and

the region of interest is a portion corresponding to a dust particle sticking to an image sensor of the image capturing apparatus.

11. The apparatus according to claim 10, wherein the first processing unit performs dust erase processing for the image data which has undergone the rotation processing by the first processing unit so as to make the dust particle unnoticeable using the information specifying the position of the region of interest rotated by the second processing unit.

12. A method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, comprising:

performing first rotation processing of the image data; and
performing second rotation processing of the region of interest in accordance with a rotation of the image data by the first rotation processing,

wherein the image data is generated by an image capturing apparatus, and

the region of interest is a portion corresponding to a frame for auto focus, the portion is used to focus on an object by the image capturing apparatus upon generating the image data.

13. The method according to claim 12, wherein the second rotation processing is performed in accordance with a rotation amount of the image data by the first rotation processing.

11

14. The method according to claim 12, further comprising controlling to display the image of the region of interest in addition to displaying an image corresponding to the image data.

15. The method according to claim 12, wherein the frame is selectable in the image capturing apparatus upon generating the image data.

16. The method according to claim 12, wherein the region of interest has a rectangular shape.

17. The method according to claim 12, further comprising, when displaying, on a display unit, an image corresponding to the image data which has undergone the first rotation processing, displaying distance image in accordance to the position of the region of interest.

18. The method according to claim 12, further comprising controlling to display a frame based on the region of interest, wherein the controlling step rotates the frame in accordance with a rotation amount of the image data by the first rotation processing.

19. A method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, comprising:

performing first rotation processing of the image data; and performing second rotation processing of the region of interest in accordance with a rotation of the image data by the first rotation processing,

wherein the image data is generated by an image capturing apparatus, and

the region of interest is a portion corresponding to a dust particle sticking to an image sensor of the image capturing apparatus.

20. The method according to claim 19, further comprising performing dust erase processing for the image data which has undergone the first rotation processing so as to make the dust particle unnoticeable using the information specifying the position of the region of interest rotated by the second rotation processing.

21. A non-transitory computer-readable storage medium storing a program for causing a computer to execute a method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, the program causing the computer to execute:

performing first rotation processing of the image data; and performing second rotation processing of the region of interest in accordance with a rotation of the image data by the first rotation processing,

wherein the image data is generated by an image capturing apparatus, and

the region of interest is a portion corresponding to a frame for auto focus, the portion is used to focus on an object by the image capturing apparatus upon generating the image data.

22. The medium according to claim 21, wherein the second rotation processing is performed in accordance with a rotation amount of the image data by the first rotation processing.

23. The medium according to claim 21, wherein the program causing the computer to execute controlling to display the image of the region of interest in addition to displaying an image corresponding to the image data.

24. The medium according to claim 21, wherein the frame is selectable in the image capturing apparatus upon generating the image data.

25. The medium according to claim 21, wherein the region of interest has a rectangular shape.

12

26. The medium according to claim 21, wherein the program causing the computer to execute, when displaying, on a display unit, an image corresponding to the image data which has undergone the first rotation processing, displaying distance image in accordance to the position of the region of interest.

27. The medium according to claim 21, wherein the program causing the computer to execute controlling to display a frame based on the region of interest,

wherein the controlling step rotates the frame in accordance with a rotation amount of the image data by the first rotation processing.

28. A non-transitory computer-readable storage medium storing a program for causing a computer to execute a method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, the program causing the computer to execute:

performing first rotation processing of the image data; and performing second rotation processing of the region of interest in accordance with a rotation of the image data by the first rotation processing,

wherein the image data is generated by an image capturing apparatus, and

the region of interest is a portion corresponding to a dust particle sticking to an image sensor of the image capturing apparatus.

29. The medium according to claim 28, wherein the program causing the computer to execute processing for the image data which has undergone the first rotation processing so as to make the dust particle unnoticeable using the information specifying the position of the region of interest rotated by the second rotation processing.

30. An image processing apparatus for performing image processing of image data, comprising:

a first processing unit configured to perform rotation processing of the image data which is generated in accordance with an object image by an image capturing unit, and to control a display unit to display a first image in accordance with the image data which is performed the rotation processing;

a second processing unit configured to control a display unit to display, with superimposing upon the first image, a second image specifying a position of a region of interest in the first image, wherein the second image is performed changing position processing for the display in accordance with a rotation of the image data by the first processing unit and the second image is rotated for the first image in accordance with a rotation of the image data by the first processing unit.

31. The apparatus according to claim 30, wherein the second image is selectable upon the first image.

32. An image capturing apparatus comprising:

an image capturing unit; and

an image processing apparatus of claim 30 which performs image processing of image data generated by the image capturing unit.

33. A method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, comprising:

performing first rotation processing of the image data which is generated in accordance with an object image by an image capturing unit, and controlling a display unit to display a first image in accordance with the image data which is performed the rotation processing; and

13

performing controlling a display unit to display, with superimposing upon the first image, a second image specifying a position of a region of interest in the first image, wherein the second image is performed changing position processing for the display in accordance with a rotation of the image data by the first rotation processing and the second image is rotated for the first image in accordance with a rotation of the image data by the first processing unit.

34. The method according to claim 33, wherein the second image is selectable upon the first image.

35. A non-transitory computer-readable storage medium storing a program for causing a computer to execute a method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is recorded, the program causing the computer to execute:

performing first rotation processing of the image data which is generated in accordance with an object image by an image capturing unit, and controlling a display unit to display a first image in accordance with the image data which is performed the rotation processing; and

performing controlling a display unit to display, with superimposing upon the first image, a second image specifying a position of a region of interest in the first image, wherein the second image is performed changing position processing for the display in accordance with a rotation of the image data by the first rotation processing and the second image is rotated for the first image in accordance with a rotation of the image data by the first processing unit.

36. The medium according to claim 35, wherein the second image is selectable upon the first image.

37. The medium according to claim 35, wherein the second image is a rectangular shape.

38. An image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is generated, comprising:

a first processing unit configured to perform rotation processing of the image data; and

a second processing unit configured to perform rotation processing of the region of interest in accordance with the rotation of the image data by the first processing unit, wherein the image data is generated by an image capturing apparatus, and

wherein the region of interest corresponds to at least one of a frame for detecting focus condition of the image or a frame for an image recognition.

39. The apparatus according to claim 38, wherein the second processing unit is configured to move the region of interest in accordance with the rotation of the image data by the first processing unit.

40. An image processing apparatus for performing image processing of image data in which additional data specifying a position of a region of interest in an image is formed, wherein the image data is generated by an image capturing apparatus, comprising:

a first processing unit configured to perform rotation processing of the image data and to control a display unit to display a first image in accordance with the image data which is performed the rotation processing;

14

a second processing unit configured to perform rotation processing of the additional data indicating the region of interest in accordance with the rotation of the image data by the first processing unit;

a third processing unit configured to process the image data within the region of interest to generate a control signal; and

a control unit configured to control the image capturing apparatus based on the control signal.

41. The apparatus according to claim 40, wherein the second processing unit is configured to move the region of interest in accordance with the rotation of the image data by the first processing unit.

42. The apparatus according to claim 40, wherein the third processing unit is configured to process the image data within the region of interest to generate at least one of a focus control signal or an image recognition signal.

43. A non-transitory computer-readable storage medium storing a program for causing a computer to execute a method of controlling an image processing apparatus for performing image processing of image data in which information specifying a position of a region of interest in an image is generated, the program causing the computer to execute:

performing first rotation processing of the image data; and performing second rotation processing of the region of interest in accordance with a rotation of the image data by the first rotation processing,

wherein the image data is generated by an image capturing apparatus, and

wherein the region of interest corresponds to at least one of a frame for detecting focus condition of the image or a frame for an image recognition.

44. The medium according to claim 43, wherein the second processing includes moving the region of interest in accordance with the rotation of the image data by the first processing unit.

45. A non-transitory computer-readable storage medium storing a program for causing a computer to execute a method of controlling an image processing apparatus for performing image processing of image data in which additional data specifying a position of a region of interest in an image is formed, wherein the image data is generated by an image capturing apparatus, the program causing the computer to execute:

performing first rotation processing of the image data and controlling a display unit to display a first image in accordance with the image data which is performed the rotation processing; and

performing second rotation processing of the additional data indicating the region of interest in accordance with the rotation of the image data by the first processing unit, performing third processing of the image data within the region of interest to generate a control signal, and controlling the image capturing apparatus based on the control signal.

46. The medium according to claim 45, wherein the second rotation processing includes moving the region of interest in accordance with the rotation of the image data by the first processing unit.

47. The medium according to claim 45, wherein the third processing is to generate at least one of a focus control signal or an image recognition signal.

* * * * *